REMARKS

In the office action, claims 14. 6-7 and 10 were pending and were rejected under 35 U.S.C.102 (b) as being anticipated by Byren et al, (5,974,061) hereinafter '061.

The applicants hold that as compared with 061, the claims of the present invention possess novelty and inventiveness based on the following reasons:

1, With respect to Claims 1 and 6

There are several major differences between Byren et al. (5,974,061, hereinafter 061) and our invention.

(1) 061 introduces a special pumping scheme based on edge-pumping or side-pumping (3/22-24). The key technique of 061 is the cylindrical outer surfaces 18 on the top and bottom cladding layers 46, 48 of the undoped cladding layer 14 (3/32-33, also in claims 1 and 13). The cylindrical outer surfaces 18 are preferably designed with a concave hyperboloid or near-hyperboloid shape. It is just these cylindrical outer surfaces 18 that makes 061 different from normal edge-pumping or side-pumping scheme. Here the cylindrical outer surfaces 18 are designed to reflect pump light and confine it in the laser slab (FIG. 1). With help of a concave hyperboloid or near-hyperboloid shape, the cylindrical outer surfaces 18 reflects pump light with decreased incident angle, and at slab center, the incident angle will be near zero, therefore theoretically, pump light from one side of the laser slab can not pass through slab center and will be confined in the half slab of the same side. This technique allows pump light to be distributed more densely in slab center than in the slab side and be largely absorbed by central portion of laser slab (because of the decreasing pump incident angle), While on the other hand, to lower pump transmission loss and increase absorption efficiency, cylindrical outer surfaces 18 must be coated to ensure high reflectivity at the pump wavelength. One can see that at the slab center, pump light is nearly perpendicular to the cylindrical outer surface 18 (i.e. incident angle is near zero), therefore, without help of high reflectivity coating, pump light will experience very high transmission loss and therefore results In a very low pump absorption efficiency. Furthermore, because one side pumping can only pump "one side", or "half slab", both sides pumping must be employed when utilizing 061's design.

While in present invention, the laser slab is cut at the slab corners to form small corner surfaces. The slab outer surfaces are all planar, compared to cylindrical outer surfaces 18 in 061. Pump light is guided into slab corner surfaces and travels inside the slab. Because all the surfaces are planar, the incident angle of the pump light after reflecting at the slab surface will remain unchanged (guaranteeing that TIR condition is always satisfied), pump light is then confined inside the slab largely by total internal reflections (TIRs) at the planar outer surfaces, and therefore a high reflectivity coating is not essential for laser operation. Unlike 061, that pump light from one side is restricted in the half slab region (see Fig. 1, 3), the present invention allows pump light from each corner face propagating throughout the whole doped region, this means in our "corner-pumped" slab laser of the present invention, the distribution of absorbed pump power is more uniform in the whole doped region, and also pump from all corners is not strictly required.

(2) 061 introduces another embodiment designed for low f/number pumping (see Fig. 3). In Fig. 3, at first glance, there are four pump surfaces accepting pump light, which seems similar with our corner-pumping method. In fact, these two approaches are different not only in slab design but also in design purpose. Please see Fig. A for comparison.

(2a) Regarding design purpose, the technical solution shown by Fig.3 of 061 is designed for low f/number pumping, the precise angle of the entrance surface of the pump cavity 34 is selected according to the application and depends on a tradeoff between pumping efficiency and suppression of lateral parasitic lasing modes (4/29-48).

While, the "Corner-pumping" method of the present invention is designed to get high absorption efficiency while maintaining relatively high pump uniformity.

(2b) Regarding slab design, Fig.3 of 061 shows "shapes and/or coat the entrance surfaces at the side edges of the pump cavity 34 to maximize transmission and avoid critical angle limitations" (4/29-32). This "shaping" approach can only increase pump transmission at the entrance surfaces when compared to that of Fig.1 being another embodiment of 061, inside the laser slab, Fig. 3 has all the technical features of 061 as mentioned above (such as deceasing incident angle for

pump light, "half slab" pumping, more pump absorption in slab center, and requirement for high reflectivity coating).

While, in the present invention, pump light from each corner face propagates throughout the whole doped region, this means the distribution of absorbed pump power is more uniform in the whole doped region, pumping from all corners is not strictly required, and also high reflectivity coating is not mandatory. From the following Fig, A, one can easily find out the difference between these two approaches.

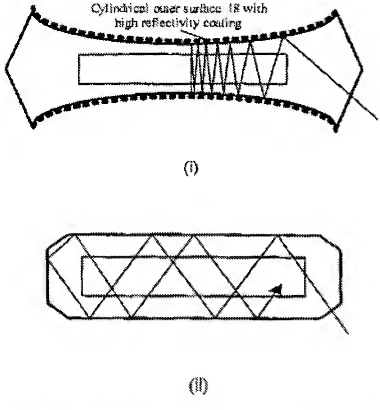


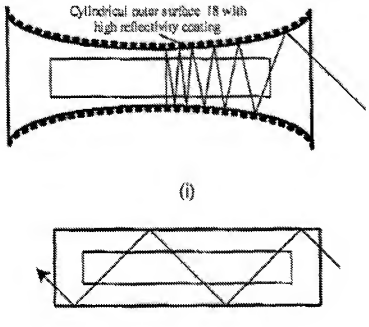
Fig. A Comparison of 061 and present invention

(i) corresponding to Fig. 3 of 061; (ii) corresponding to the present invention

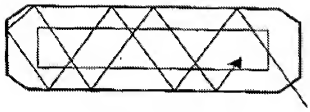
The applicants would like to emphasize the importance of cylindrical outer surfaces 18 (especially with a concave hyperboloid or near-hyperboloid shape) to 061 again. Without cylindrical outer surfaces 18, i.e. if the outer surfaces 18 are planar (see following Fig. B-ii),

pump light will pass through the whole doped region, and finally travels out of the slab. This will results in relatively high pump transmission loss.

While in present invention, slab outer surfaces are all planar, by benefiting from corner pumping technique, pump light is well confined inside laser slab largely by total internal reflections (TIRs), and will exhibit lower transmission loss, also the pump light distribution is more uniform than 061 (see following Fig. 6-iii).



(ii)



(iii)

Fig. B Comparison of pump light path and distribution.
(i) 061; (ii) 061 with plane outer surfaces; (iii) present invention.

With careful consideration of examiner's comments, to clarify the most important difference between 061 and our invention, i.e., outer surface shape, the applicants amend claims 1 and 6 by adding a technical feature "outer surfaces of said slab are planar."

2. With respect to Claim 13

In Zhang (6,873,639, hereinafter 639), two cylindrical lenses without lens duct are provided, and the generatrices of these two cylindrical lenses are parallel, but not orthogonal. The usage of these two cylindrical lenses is to form a one- dimensional spatial filter (25/3-8) or a beam expander or reducer (25/8-11) only in the slow-axis plane of the laser diode bar.

While in present invention, the coupling system includes two cylindrical lenses and a lens duct, the generatrices of the two cylindrical lenses are orthogonal to each other and are parallel to fast axis and slow axis of the diode array, respectively. The usage of these two cylindrical lenses is to collimate the pump beam both in fast and slow axes of the diode array. After collimating, the lens duct is used to compress and direct the pump beam into corner surface of the laser slab.

Thus, the technical features of claim 13 of present invention: "said coupling system including two cylindrical lenses and a lens duct" and "generatrices of said two cylindrical lenses are

orthogonal to each other and are parallel to fast axis and slow axis of said diode array, respectively" are not disclosed or suggested by 061 and 639, and are not obvious at the time the invention was made to a person having ordinary skill in the art.

To sum up, the technical feature " outer surfaces of said slab are planar" in amended claims 1 and 6 of present invention, and the technical features: "said coupling system including two cylindrical lenses and a lens duct" and "generatrices of said two cylindrical lenses are orthogonal to each other and are parallel to fast axis and slow axis of said diode array, respectively" in claim 13 of present invention are not disclosed or suggested by 061 and 639, and are not obvious at the time the invention was made to a person having ordinary skill in the art. Therefore, as compared with 061 and 639, amended independent claims 1 and 6 of present invention should possess novelty and inventiveness. Further, each of dependent claims also possess novelty and inventiveness, at least by virture of their dependency.

In conclusion, Applicants respectfully submit that all claims are patentable and request a Notice of Allowance be issued. If the Examiner has any questions or needs any additional information, the Examiner is invited to contact the undersigned.

Respectfully submitted,
Mali Gong et al.

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By /Aaron Wininger, Reg. No. 45,229/
Aaron Wininger
Attorney for Applicants
Reg. No. 45,229

Squire, Sanders & Dempsey L.L.P.
600 Hansen Way
Palo Alto, CA 94304-1043
Telephone (650) 843-3375
Facsimile (650) 843-8777